

Completed Project (2014 - 2014)

# Self Healing Coating/Film Project

Center Independent Research &amp; Developments: KSC IRAD Program | Science Mission Directorate (SMD)



## ABSTRACT

Kennedy Space Center (KSC) has been developing self healing materials and technologies. This project seeks to further develop self healing functionality in thin films for applications such as corrosion protective coatings, inflatable structures, space suit materials, and electrical wire insulation.

## ANTICIPATED BENEFITS

### To NASA funded missions:

- increase material/system reliability
- reduce life cycle costs, and
- improve operational safety

### To NASA unfunded & planned missions:

Self-healing, multi-functional materials have been identified as critical technologies for increased sustainability and reliability in space exploration. NASA and the aerospace community still lack self-healing capabilities in systems such as wiring, protective coatings and habitation structures.

When developed, this technology will add new functionality, reduce life cycle cost, increase the safety and reliability of deep space missions, as well as benefit the public after commercialization in such areas as coatings, medical, electronic and composites industries.

### To other government agencies:

Technology advances in self healing and wire insulation materials can benefit many other government agencies such as the US Department of Defense, Department of Transportation, and Department of Energy.

### To the commercial space industry:

Self healing materials and technologies can have game

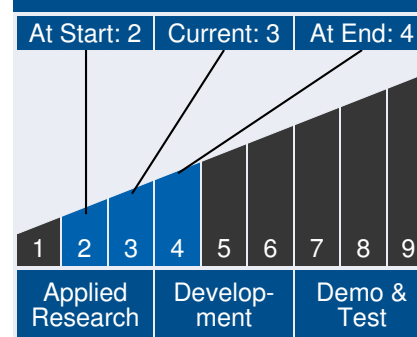


1000 hour salt fog testing result

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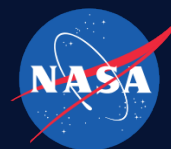
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## Technology Maturity



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changing impacts for deep space exploration and habitation missions, as well as commercial aviation and the oil industry.

## To the nation:

Self healing corrosion protective coatings would provide benefits for all industries that are affected by the high costs and safety concerns associated with corrosion failures.

Self healing wire insulation could provide much needed new materials for all industries that involve electrical and electronic systems. An example is the aviation industry that has been battling wire damage in aged aircraft for a long time. Self-healing wire would be a much welcomed technology breakthrough.

## DETAILED DESCRIPTION

Self healing technologies could significantly increase material/system reliability, reduce life cycle costs, and improve operational safety. Kennedy Space Center (KSC) has been developing self-healing technologies and has established intellectual properties in this area. One of KSC's approaches is encapsulating healants in microcapsules with spherical and elongated shapes so that the contents can be released automatically when the system is damaged. The other approach involves synthesizing and utilizing polymers that are capable of self-sealing when mechanical damage, such as a scratch, occurs.

### Management Team

#### Program Director:

- Burton Summerfield

#### Program Executive:

- Karen Thompson

#### Program Manager:

- Nancy Zeitlin

#### Project Manager:

- Pamela Mullenix

#### Principal Investigators:

- Luz Calle
- Martha Williams

### Technology Areas

#### Primary Technology Area:

Ground & Launch Systems Processing (TA 13)

#### Other Technology Areas:

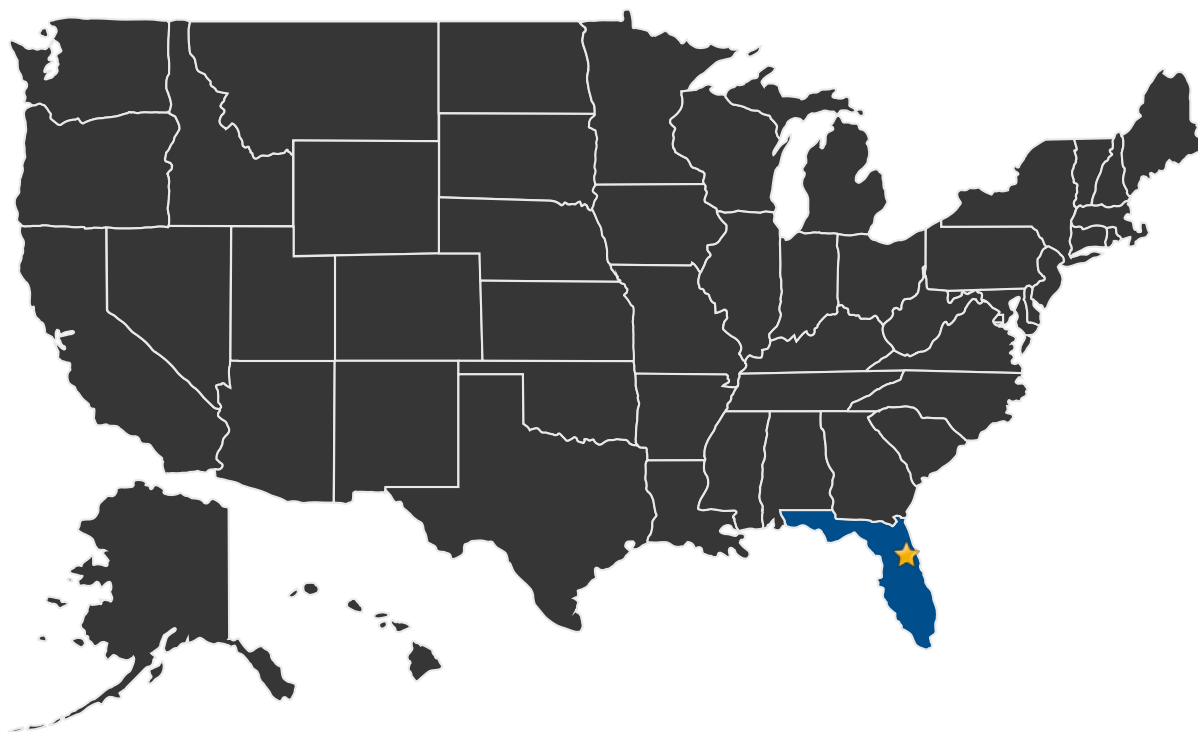
- Space Power & Energy Storage (TA 3)
- Human Health, Life Support & Habitation Systems (TA 6)
- Materials, Structures, Mechanical Systems & Manufacturing (TA 12)

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### U.S. LOCATIONS WORKING ON THIS PROJECT



■ U.S. States With Work

★ **Lead Center:**  
Kennedy Space Center

● **Supporting Centers:**

- Kennedy Space Center

**Other Organizations Performing Work:**

- QinetiQ North America/ ESC

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## DETAILS FOR TECHNOLOGY 1

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### Technology Title

Self-healing coating/ thin film

### Technology Description

This technology is categorized as a material for ground support or mission operations

Self-healing is a new and developing technology area. Self-healing in thin films can be more challenging than in thicker films or bulk materials, such as composites, due to geometry limitation. Two approaches are being investigated: microencapsulated healants and self-sealing polymers. While one provides a quick response, the other allows repeatable repair. Both approaches are desirable for self healing materials. Progress was made in both approaches for improved healing efficacy. It is likely that more than one approach would be needed for optimized results in more demanding applications, such as space suit materials.

### Capabilities Provided

Self-healing capability: The capability of self healing in thin film forms will enable incorporation of the self-healing function into existing materials and structures. Self healing can be included in corrosion protection coatings, wiring insulation, and inflatables. Although proof of concept has been demonstrated in bulk materials and thick films, it has been challenging to incorporate the self healing function into existing materials, without making significant modification, while maintaining other properties. This project seeks to make technical progress in this area.

### Potential Applications

- corrosion protective coatings
- inflatable structures
- space suit materials
- electrical wire insulation